versationslexicon," in many volumes, as the principal ornament of its parlour, and here Schoedler's "Book of Nature" might also find a home. Dr. Schwalbe's volume, now before us, forms a part of the twenty-third edition of Schoedler's stately work, a "circle of the sciences" that still continues to revolve. The first part of the "Buch der Natur" has, it appears, already dealt with the life of plants and animals, and the palæontological history given by Dr. Schwalbe (pp. 193-230) is consequently only a slight sketch. The tremendous changes that have taken place from epoch to epoch in the predominant life-forms on the globe appeal to most minds that seek self-instruction in geology; to such the present treatise must appear phenomenally dry. Dr. Ernst Schwalbe, however, a son of the author, interpolates thirteen pages styled "Einige Worte vom Darwinismus," which lead to most just conclusions, but which are far more zoological than geological. The author's decease during the progress of the book has thrown much labour on the editor, Dr. Böttger, who has been asked to piece together detached portions of manuscript, and to supply important passages himself. He has certainly kept the work very fairly up to date, as in the description of the human remains in the Krapina valley, in Croatia (p. 592), and the expanded section on crystallographic symmetry (pp. 603-646); but such additions are often far removed from the matter on which they bear in the main text. The book opens, in fact, with a severe and very chilling account of crystal-forms, in which Naumann's symbols are prevalent, and in which the positions adopted for some of the drawings leave much to be desired. The optical characters, which are so much relied on nowadays, are dismissed in two pages, and the distinction between uniaxial and biaxial crystals is given with time-honoured incompleteness. The blowpipe-examination of minerals, so fascinating to schoolboys and to those working by themselves, is not dealt with from a practical point of view; and the description of minerals would give the beginner little conception of the connection of these bodies with the earth on which we live. The beauty of the objects is occasionally dwelt on; but their common mode of occurrence, and their geological relations, are left to a general chapter on mineral deposits, which follows the detailed catalogue of species. The account given of the felspars and other rock-forming minerals has very little value for the geologist, and bears signs of considerable antiquity.

The petrography is similarly in need of vitalising touches. The group of "lavas," as distinct from basalts and trachytes, is retained; and the inner meaning of rock-structures is not discussed. After a palæontological and stratigraphical episode, we return to petrography, on p. 216, with the almost extinct division of igneous rocks according to geological age. Then we swing back to palæontology, and to a table "nach Gümbel," which naturally takes no account of the recently disclosed richness of the Cambrian fauna of America. And so on, classically enough, until we ask why, with so many good German text-books in existence, gymnasia are to be treated to these special products of desiccation. May not the pupil exclaim, "And it was full of bones; and he caused me to pass by them round about; and lo, they were very dry"?

The sections on denudation and aggregation are, however, much more cheering, and the photographic illustrations are mostly new and excellent. From them the student may gain a real feeling for the varied aspects of the earth. The three plates showing the changes in the Karlseisfeld, in the Austrian Alps, at intervals of about ten years, are beautiful and impressive. But we are soon after (p. 603) drawn on into a series of "gemischte Waaren" in the form of separate articles, confirming or expanding what has gone before. Thus, "Crystallographic systems," 45 pages; "Nomenclature," 35 pages, in which the derivation of mineral names is given, with original Greek words and their transliterations into Latin letters; "On Caves," 22 pages; "Orogeny," 35 pages, with many modern features and admirable illustrations. Dr. Böttger has clearly had a difficult task in pouring new wine into old bottles. We gather (p. 744) that geology has no distinct place in the curriculum of the Prussian high schools, although mineralogy and petrography are admitted; and the late Dr. Schwalbe worked hard to introduce geological illustrations into the experimental work of other subjects. In the twenty-fourth edition of the "Buch der Natur," Dr. Böttger may have the opportunity of recasting this volume, and of abolishing the system of appendices; but for school work something more practical is required. It is to be feared that the Prussian scheme of education does not favour individual experiment; but the pupil cannot understand geology unless he has scratched his minerals with a knife, and gathered his fossils on the bare hillside. The Pomeranian plain is not ideal for such a purpose; but, even there, every field contains its treasures, and the glorious ice-borne blocks from Scandinavia give colour to each village street. The history of one of these, from pre-Cambrian to gymnasial days, is worth a thousand pages of conscientious compilation.

GRENVILLE A. J. COLE.

CURIOSA MATHEMATICA.

Opinions et Curiosités touchant la Mathématique. Deuxième Série. By Georges Maupin. Pp. 332 (Paris: C. Naud, 1902.) Price 5 francs.

THIS is a very entertaining miscellany in which every reader will find something to his taste. Thus we have extracts from the works of sixteenth century mathematicians, still influenced by the methods of scholasticism; part of the debate in the Chamber of Deputies (August, 1835) on the French jury system, when Arago appealed without effect to the mathematical theory of probabilities; two specimens of circle-squaring (1852, 1855); and so on. Two or three extracts will serve to show how amusing some of these chapters are.

John Wilkins, after criticising adversely the cabalistic methods of the Jews, argues in true scholastic

fashion against the existence of more than six principal planets :—

" Or si quelqu'un demande, pourquoy il n'y a que six orbes des Planettes, Keppler respond :—Parce qu'il ne faut pas qu'il y ait plus de cinq proportions, tout autant qu'il y a de corps réguliers és Mathematiques, dont les costez et les angles sont esgaux les vns aux autres.—Or six termes accomplissent le nombre de ces proportions; et par conséquent il n'y peut auoir que six principales Planettes."

Could anything be more convincing? Perhaps, after all, Uranus and Neptune are mere *simulacra*, will-o'-the-wisps contrived by Satan to deceive a reprobate race of astronomers no longer faithful to the great principles of analogy.

We have the authority of the Reverend François Chevillard (1667) for believing that mathematicians are (or should be) born under the sign of the Twins. He says :—

" *Les Iumeaux.*—Ce signe rend son homme beau, misericordieux, sage, ingenu, libre, vn peu menteur, coureur et voyageur, mediocre en commoditez, assez fidelle pour estre Intendant des Finances, propre aux Mathematiques, aux Loix, et à l'Arithmetique, sçachant dissimuler sa cholere, mais il sera pour courir danger vers l'âge de trente-deux ans ou du feu, ou du fer, ou de la morsure de quelque chien. . . ."

Here is something more properly mathematical. John Abraham (1607) gives the product $6757 \times 346 = 2337922$, and after explaining the test by " casting out the nines," proceeds as follows :—

" Et d'autant que la preuue de 9 n'est si certaine que le contraire ou la preuue de 7 (*sic*). Nous auons fait la preuue par 7. Et pour ce faire faut chasser les 7 dizaines de la somme à multiplier, sçauoir de 67 restent 4 de 45 restent 3 et de 37 restent 2 qu'il faut poser à l'un des bras de la croix " (that is, the cross used in the old-fashioned way of casting out the nines : but Abraham's cross is like a big +), " puis en la forme susdite faut aussi chasser les 7 du multiplieur, sçauoir de 34 restent 6 et de 66 restent 3 qu'il faut poser à l'autre bras de la croix, et multiplier les deux figures l'vne par l'autre, sçauoir 2 fois 3 sont 6 qu'il faut poser sur le haut de la croix et pour la fin de la preuue faut chasser les 7 des 2337922 de 23 restent 2 de 23 restent encores 2 de 27 restent 6 de 69 restent 6 de 62 restent 6 et encores des 62 restent encores 6 qu'il faut poser au bras de la croix."

It will be observed that this amounts to finding the least positive residues of the factors with respect to the modulus 7, and comparing their product with the residue of the product of the given numbers. The residues are found by actual division, not by any special rule; curiously enough, it does not appear how the author found the 9-residues for the other test. No proofs are given to justify the process in either case.

The second part of Mr. Maupin's book (p. 160 to end) deals mainly with the notes of Albert Girard to the mathematical works of Stevinus. Both these men were very competent mathematicians, and a study of their work is very instructive. In their day, the science of mathematics was but little advanced beyond the stage at which it had been left by Pappus, Diophantus, and Ptolemy; the notation of analysis was still very imperfect; the methods of analytical geometry and infinitesimal calculus, as we now know them, had not been invented; the prevailing style of demonstration, as it appears to a modern reader, was both involved and diffuse. But the times were ripening for the great discoveries of Newton, Descartes, and Leibniz; and if, as compared with the achievements of their immediate successors, the work of men like Stevinus seems poor and insignificant, we must remember that the work of these humble pioneers was probably more important than appears at first sight. No one who has studied the history of mathematics can have failed to see how advance in the subject has accompanied improvement in notation. Now the essential features of modern notation are due to the mathematicians of the earlier part of the seventeenth century; and their service in devising it is really considerable. Besides this, they were the teachers of the younger mathematicians of their time; and we may not unfairly credit them with having done nothing to spoil and something to stimulate the minds of men with greater genius than their own.

The ingenuity of some of these old worthies, especially in diophantine analysis, is really remarkable, and it is not always easy to see precisely their method of procedure; for, after the manner of their time, they publish results without demonstrations. Some very curious results obtained by Girard (pp. 203-9 of Mr. Maupin's book) seem to show that he was acquainted with the reduction of a quadratic surd to a periodic continued fraction; thus he obtains $1039681/328776$ as an approximate value for $\sqrt{10}$, and this rational fraction is, in fact, the eighth convergent to the infinite continued fraction which represents $\sqrt{10}$. G. B. M.

ASTRONOMY FOR EXPLORERS.

Grundzüge der astronomisch-geographischen Ortsbestimmung auf Forschungsreisen. By Prof. Dr. Paul Güssfeldt. Pp. xix+368. (Braunschweig : Vieweg und Sohn, 1903.)

AS the field of the geographical explorer daily narrows, so do the number and excellence of books dealing with geographical exploration continually increase. The book under review treats of the determination of time, latitude and azimuth with a transit theodolite, and the methods described are the simplest in use by the explorer; it will serve, however, as an introduction to field astronomical methods generally.

The author leaves nothing unexplained, and commences with elementary definitions of number and quantity. A quarter of the book deals entirely with elementary arithmetic, algebra, trigonometry and analytical geometry. This is, perhaps, an excess of thoroughness; for the explorer in most cases wants to get to business as soon as possible, and if he has not previously obtained a knowledge of the elements of these matters, he is more than likely to be content to use accepted formulæ without investigation, so that it is not quite clear for what class of reader the book is written.

It appears from the publishers' preface that Dr. Güssfeldt has had considerable experience of field